Brookhaven National Laboratory National Synchrotron Light Source	**Number:** LS-PPS-0022	**Revision:** C
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Subject: **VUV Ring Radiological Interlock Test**

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*Approval signatures on file with master copy.

Revision/Periodic Review Log

Test Reason:	Test Result: ☐ Passed ☐ Failed	
	Test Type: ☐ Full ☐ Partial	
Test Date:	Start Time:	Finish Time:
Tester 1:	Assistant 1:	
Tester 2:	Assistant 2:	

PREPARATION:

a. Inform Control Room Operator that a VUV Interlock test will be done. _____

b. LOTO the LEBT valve and LINAC low level RF amplifier. _____ _____

c. Verify VUV main power supplies and LINAC modulators are in a ready state where they can be turned ON. _____ _____

1. Search the VUV ring with one person remaining inside at the security control rack. The person outside times the audible alarm.

   Audible alarm sounds for at least 15 seconds _____

   The person inside watches the VUV ring Secure 'A' indicator.

   The indicator lights after the warning sound is complete _____

   The Area Secured light in the control room is on. _____

   The five beacons surrounding the VUV ring are flashing. _____ _____ _____ _____ _____

2. Open the entry gate.

   Observe the Ring Secure 'A' & 'B' indicators go out _____ _____

   The indicator on CS-E goes out _____

   The five beacons surrounding the ring go out. _____ _____ _____ _____ _____

   The Area Secured light in the control room is out. _____

   An alarm is reported to the control room alarm panel/micro. _____

   Close the gate.

3. Press CS-E (Check station at exit).

   Pilot on CS-E does not come on _____

   The ring interlock does not activate _____

4. Press CS-2, CS-3, CS-4 and CS-E.
   Neither pilot light stays on
   Open the gate and then close the gate.
   Press in order CS-4, CS-3, CS-2, CS-1 & CS-E
   Interlock does not activate.
   Open the gate and then close the gate.

5. Press CS-1 and start timing,
   The check station pilot lights turn off in ≤ 2 min.
   Press in order CS-2, CS-3, CS-4, and CS-E
   Pilot on CS-E does not come on
   Ring interlock does not activate.

6. Test the following emergency stop switches one at a time below.
   ES1 - Emergency Stop on VUV security rack
   ES2 - Emergency Stop on VUV mezzanine
   ES3 - Emergency Stop on VUV wall (near U11)
   ES4 - Emergency Stop in control room. Note: ES4 will drop security in LINAC/Booster and VUV ring.

	ES 1	ES2	ES3	ES4
Press an emergency stop.				
ES pilot 'A' in security rack goes out				
ES pilot 'B' in security rack goes out				
Emergency Stop Latch 'A' indicator goes out				
Emergency Stop Latch 'B' indicator goes out				
Reset emergency stop				
ES pilot 'A' in security rack come ON				
ES pilot 'B' in security rack come ON				
Emergency Stop Latch 'A' indicator remains out				
Emergency Stop Latch 'B' indicator remains out				
Press the reset switch on the security rack				
Emergency Stop Latch 'A' indicator comes ON.				
Emergency Stop Latch 'B' indicator comes ON.				

7. Rotate the lockout switch to OFF and attempt to secure the VUV ring.
   Observe the ring does not secure.
   Rotate the lockout switch to the ON position.

8. Secure VUV ring, with someone inside. Request someone in control room open VUV injection shutter.

   Verify the Injection Shutter Open light in the control room comes ON. _____

   Listen to and time injection audible alarm.

   Alarm sounds for at least 3 - 5 seconds _____

   And repeats every 10 - 13 seconds _____

   The IR4 rotating beacon is on. _____

9. Attempt to Enable the Master Shutters for the VUV ring

   Observe that the shutters do not enable. _____

10 Turn off Lockout switch in security rack.

   Injection Shutter Open light in control room goes out. _____

   The Injection Shutter Closed indicator on SR9 is ON. _____

   Rotate the Lockout switch to the ON position.

11. Turn ON modulators where the H.V. is ON and the MODs are pulsing

   Secure the VUV ring and the LINAC Booster. Have a person posted at the modulators to observe the status of the A & B chains.

   Turn on Dipole and set to injection level. Open the Injection shutter.

   Adjust the A limit of the dipole current sensor to 2 digits greater than the present setting.

'A' Chain Set point	
Orig.	New

   The injection shutter closes. _____

   The Dipole Current in Range light goes out. _____

   The modulators Chain A drops out momentarily until the injection shutter closes. _____

   Return the A limit switch to its original setting.

'B' Chain Set point	
Orig.	New

12. Open the Injection shutter. Adjust the B limit of the dipole current sensor to ~ 2 digits greater than the present setting.

   Modulator Chain 'B' drops-out momentarily until the injection shutter closes. _____

   Return the B limit switch to its original setting and Reset Modulators.

13. Open the injection shutter Start_____MeV End _____ MeV

   Reduce the dipole current setting by ~2950 counts Start_____ Counts End _____ Counts

   Observe the injection shutter closes. _____

14. Open the Injection shutter and manually activate the air solenoid for the U1 safety shutter.

   Observe the injection shutter closes. _____

   The modulators Chain A drops out momentarily until the injection shutter closes. _____

15. Open the injection shutter. Open the VUV gate.

    Observe the injection shutter closes. _____

    Modulators A and B chains momentarily drop out until the injection shutter closes. _____ _____

    An audible warning sounds in the VUV for 5 seconds when the gate is opened. _____

    VUV Security Alarm sounds in Control Room _____

    Re-secure the VUV ring.

16. Switch to Access Mode with the control room switch. Press Entry Permit button in control room.

    Lock releases on gate and sign changes to green. _____ _____

    Open the gate.

    VUV interlock does not dump. _____

    Close gate, release permit button.

    Gate is locked _____

    Open gate by releasing lock on inside of gate.

    VUV interlock dumps _____

17. Re-secure the VUV ring. While in Access Mode and injection shutter enable state (i.e. dipole current in range) attempt to open the injection shutter.

    The VUV injection shutter does not open. _____

    Open the injection shutter using the jumper cable designed for that purpose.

    Observe that the modulators A chain drops out while the injection shutter is open. _____

18. Switch from Access mode to Normal

    Observe an audible warning sounds in the VUV area for 10 to 15 seconds _____

19. Break security using the Interlock Off button on Mezzanine.

    Observe that there is no audible warning in the VUV ring. _____

    Pilot Light on CSE goes out _____

    VUV interlock drops out _____

    Search VUV ring

    Break security using the Interlock Off button on VUV Security Rack.

    Observe that there is no audible warning in the VUV ring. _____

    Pilot Light on CSE goes out _____

    VUV interlock drops out _____

20. Place holders on gate switches A and B and then secure the VUV ring.
Turn ON VUV power supplies as listed below and then Open the injection shutter..
Remove the B switch holder. Observe the following:

The modulators 'A' & 'B' chain drops out momentarily until the injection shutter closes.	____	____
The 'B' Chain trips first		____
The SR9 VUV Ring Secure 'A' indicator stays ON.		____
The SR9 VUV Ring Secure 'B' indicator goes out.		____

	Power Supply									
	Dipole	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**SEXT F**	**SEXT D**
Dipole trips off	____									
Remaining power supplies stay ON		____	____	____	____	____	____	____	____	____
Indicator shows trip on Dipole	____									
No Indicator showing trip on remaining supplies		____	____	____	____	____	____	____	____	____

Replace switch holder.
Use the B Test key (F-300) to reset the B chain

Observe the B secure light is on.	____

21. Open the injection shutter and turn on VUV power supplies as listed below.
Remove the A switch holder.

Modulators 'A' & 'B' chain drops out momentarily until the injection shutter closes.	____	____
The 'A' Chain trips first		____
The VUV Ring Secure 'A' indicator goes out.		____
The VUV Ring Secure 'B' indicator stays ON.		____

	Power Supply									
	Dipole	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**SEXT F**	**SEXT D**
All Power Supplies Trip-OFF (as per indicators)	____	____	____	____	____	____	____	____	____	____

Replace Switch A Holder

22. Secure the VUV Ring.

	RF1	RF2
Turn ON RF Systems 1 & 2. Monitor the cavity field. Pull Switch A holder. Observe that RF1 goes OFF for a minimum of 75 ms and RF2 goes OFF for a minimum of 10 ms.	____	____

23. Press the Interlock Off button. Remove the switch holders and check that each switch "clicks" when making contact with the gate upon closing. ____ ____

24. Remove the "Magnet Test Mode key" from SR9

The Magnet Test Mode indicators change from Normal to Test. ____

Attempt to secure the VUV ring

Observe that the ring does not secure. ____

The five beacons that surround the ring are on and flashing. ____ ____ ____ ____ ____

The Do Not Enter sign at the gate is on. ____

Replace the "Magnet Test Mode Key" and turn to normal position.

25. In control room, set shutter command to "close" and return access switch to normal. ____

Remove red tag from the LINAC low level RF and LEBT valve. ____

Inform the control room operator that test is complete and make request an entry in operations shift log and in interlock maintenance log. ____

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